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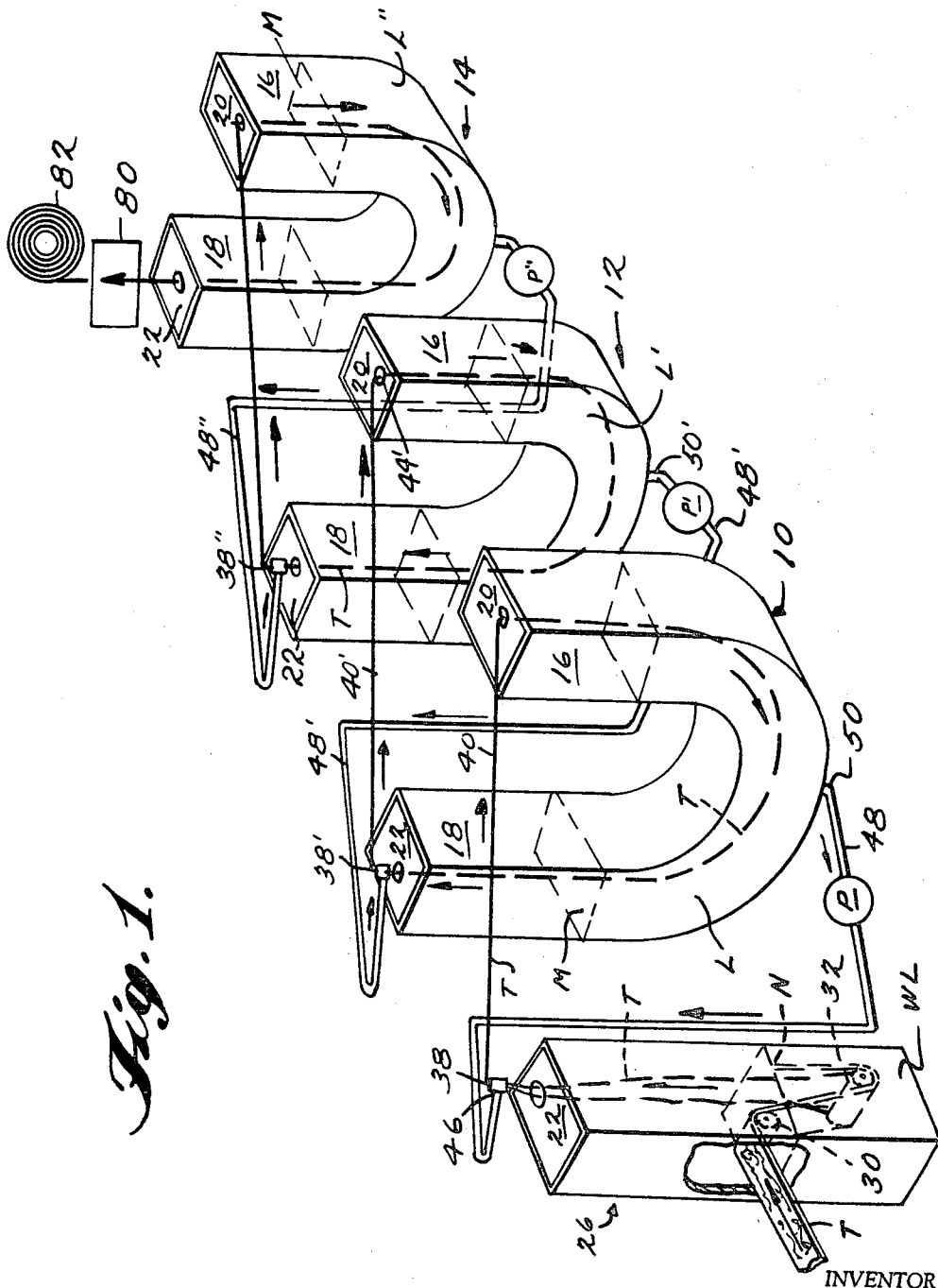
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3,409,919

PROCESS FOR TREATING TEXTILE MATERIAL SEQUENTIALLY IN A
SERIES OF LIQUID TREATMENTS

Original Filed Sept. 28, 1965

3 Sheets-Sheet 1



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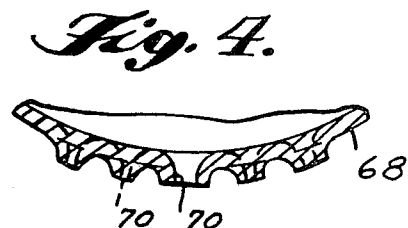
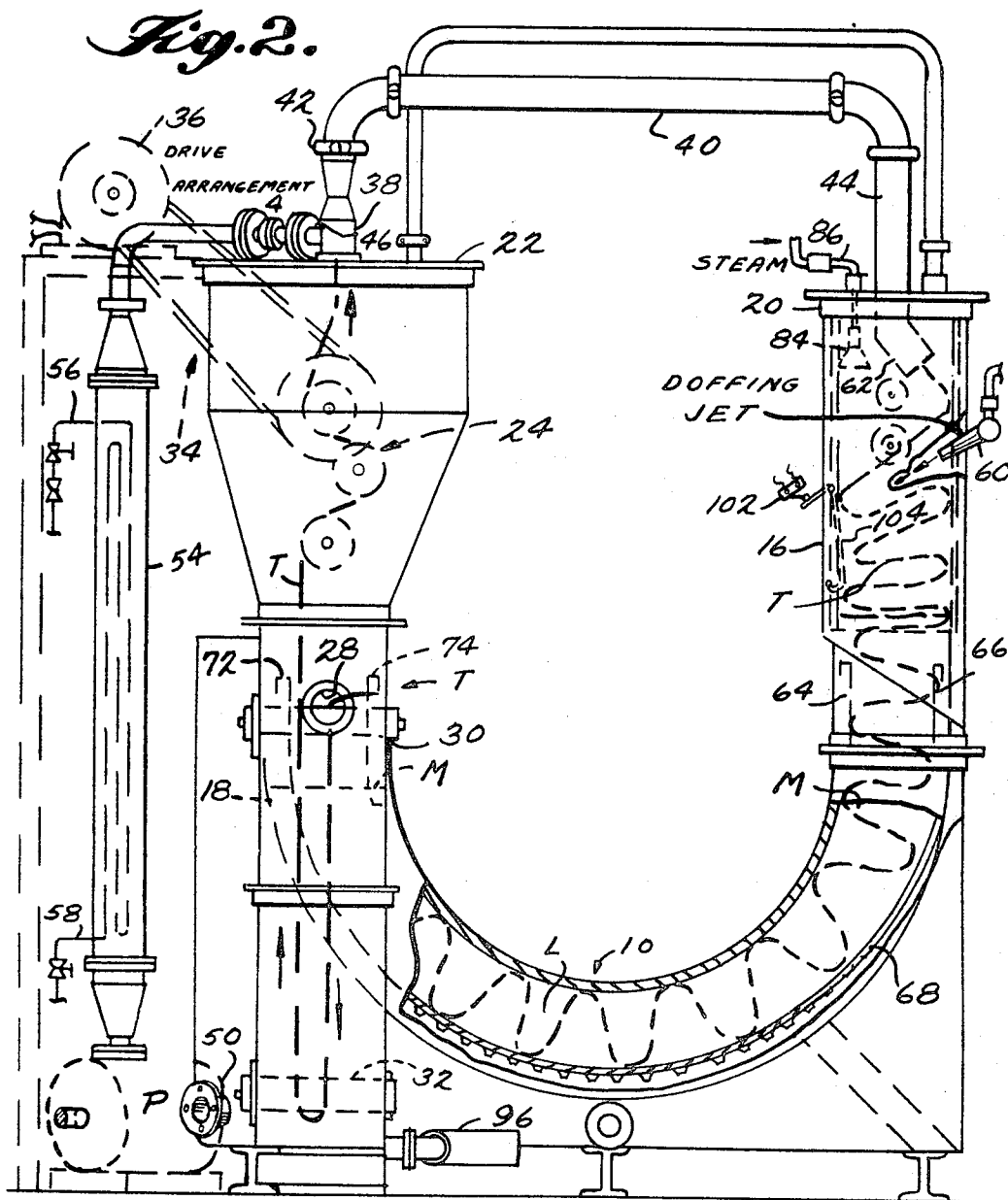
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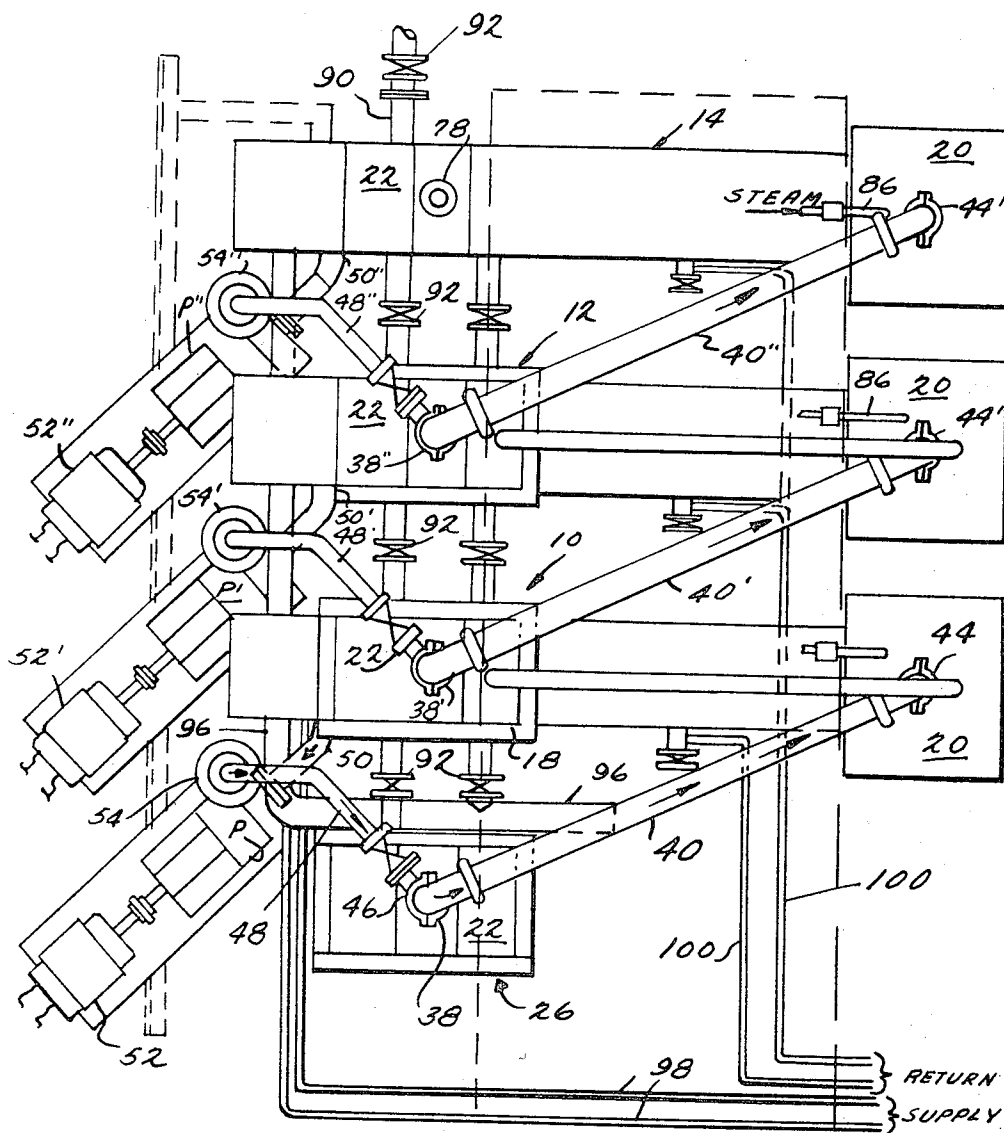


Fig. 3.

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PROCESS FOR TREATING TEXTILE MATERIAL SEQUENTIALLY IN A SERIES OF LIQUID TREATMENTS

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Original application Sept. 28, 1965, Ser. No. 490,846, now Patent No. 3,330,134, dated July 11, 1967. Divided and this application Feb. 2, 1967, Ser. No. 627,582

8 Claims. (Cl. 8—152)

ABSTRACT OF THE DISCLOSURE

A process for treating textile material such as a fabric in rope form sequentially in a series of treating liquids. The process comprises passing the fabric through a confined path into a first liquid bath and from the first liquid bath, further passing the fabric in another confined path into at least a second liquid bath. Liquid from the first bath is utilized to convey the fabric through the confined path to the first bath, the liquid being recycled into the first bath. Liquid from the at least second bath is utilized to carry the fabric in the confined path to the second bath with the liquid being recycled into the second bath.

This application is a division of my copending application Ser. No. 490,846 (now United States Patent No. 3,330,134), filed Sept. 28, 1965, and is entitled to the filing date thereof.

The present invention relates to an improved method for treating textile materials continuously and sequentially through a series of liquid treatments. More specifically, the present invention is especially useful as a method in which fabric in rope form is treated with different liquids, such as in the liquid fabric treatment processes of dyeing, or washing, or desizing, or bleaching, or the like.

Heretofore, in the continuous treatment of textile material, the material was fed in open width successively through a plurality of large tanks or vats having suitable treating liquid therein, the tanks or vats being provided with complicated drive systems and fabric handling means for conveying the material in open width. Such systems were usually open systems because of the complexity in pressurizing each of the tanks or vats as it was necessary to use special seals to permit the feeding of the fabric in open width into and from the individual tanks. Because of the necessity of immersing the textile material in each tank for a sufficient length of time to provide for adequate treatment by the particular liquid in the tank, it was necessary to make the tanks relatively large as they had to not only be of a width sufficient to accommodate the textile material in open width but they also had to be a length to permit the textile material to remain in the liquid for the required time. These prior continuous systems involved considerable floor space in the textile treating plant and required the use of large quantities of treating liquids in which the chemicals could not be economically exhausted. Consequently, the overall cost of operation of these prior continuous systems was high and resulted in an increase in the cost of the goods produced.

In order to conserve space and to reduce the cost of treating liquids, individual apparatus were developed for the batch treatment of textile material. In a batch treatment apparatus, chemicals such as dyestuffs could be effectively exhausted thus providing for the maximum amount of fabric treated for a particular batch. Such a batch apparatus is disclosed in the U.S. Patent 2,978,291 of the assignee of the present invention, issued Apr. 4,

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1961, to Victor T. Fahringer. In the aforementioned patent an apparatus is disclosed for treating fabric in rope form, rather than in open width form, the textile material having its ends sewed together so as to provide an endless rope, the rope then being circulated in this closed form into and out of the treating liquid by means of a jet of liquid moving the textile material in a confined path above the treating liquid. The jet of liquid was produced from the recirculation of the treating liquid in the tank. While the apparatus disclosed in the aforementioned patent had advantages over the continuous operation of successively moving fabric in open width through a series of tanks or vats in that better utilization of the treating liquid was obtained as well as less floor space being required for the particular unit, the time element for treating the textile material was not improved noticeably as many units had to be used when the material had to be treated with different liquids and it required individual loading and unloading of the particular units.

An important object of the present invention is to provide an improved process for continuously treating textile material in rope form through a plurality of treating liquids, the process providing for increased production at less operating cost and less floor space than processes and apparatus heretofore used.

Another object of the present invention is to provide an improved process for treating textile material which has the advantages of both the prior batch systems and the continuous systems of treatment with liquids.

Still another object of the present invention is to provide an improved method which is particularly adapted for use in continuous operations involving treatment of textile material by a plurality of separate liquid baths, some of which may have different treating liquids therein, at either elevated pressures and temperatures or at room pressures and lower temperatures.

These and other objects and advantages of the present invention will be apparent from the following detailed description of the invention.

Broadly stated, the present method comprises the steps of providing a plurality of liquid baths arranged in series, some of the baths having different liquid; passing textile material such as fabric in rope form sequentially through the liquid of each bath; and utilizing liquid withdrawn from a particular bath to form a jet stream of liquid for feeding the fabric in a confined path to that bath from the previous bath, the jet stream of liquid being recirculated into the bath from which it is withdrawn. Further, the present method contemplates directing a high speed stream of fluid against the textile material as it is being discharged from the confined paths downwardly into the respective baths, the high speed fluid jet causing the material in rope form to neatly plait or orderly pile in the bottom of the baths as it is being conveyed through the baths. In some instances, the method of treating the textile material in rope form continuously involves elevating the temperatures of the baths and, thus, elevating the pressure under which the textile material is continuously conveyed through the series of baths. This is accomplished when the treating liquid requires the same for optimum results.

An important feature of this invention, as broadly described above resides in the step of a continuous liquid treatment of textile material in rope form sequentially through a series of liquid baths, the material being open rather than closed as in the case where the ends of the material are sewed together so that the material is an endless loop continuously passed into and out of a particular bath. This highly advantageous method of handling textile fabric in rope form, as mentioned above,

materially decreases the processing time in that there is no delay in forming the material into a loop and then, after treatment in a particular liquid, disconnecting the loop and reforming the loop for another treatment with a different liquid. Additionally, the continuous operation results in a more even treatment of the fabric in rope form in a particular liquid, for example, dye liquor, as all portions of the material are treated in the same time in a particular liquid and there is no cracking or stretching of the fabric.

The invention will be further described with reference to the accompanying drawings in which:

FIGURE 1 is a diagrammatic perspective view of an apparatus for accomplishing the process of the present invention the views illustrating the feed path of the textile material through the apparatus as well as the flow paths of the recirculating liquid utilized to form the jet stream of liquid for feeding the material sequentially to the various liquid treatment baths;

FIGURE 2 is a side elevational view partly broken away of the apparatus of the present invention;

FIGURE 3 is a top plan view of the apparatus illustrated in FIGURE 2, portions of the apparatus being omitted for the purpose of clarity; and

FIGURE 4 is an enlarged fragmentary sectional view of the false bottom or grid provided in each of the tanks for the various liquid treatment baths.

Referring now to the drawings wherein like characters or reference numerals represent like or similar parts, there is disclosed a plurality of vessels 10, 12 and 14 for treating liquid L, L' and L''. The vessels 10, 12 and 14 may take the form of J-box tanks, each having an inlet chamber 16 and an outlet chamber 18 above the level of liquid M therein as shown in broken lines. Covers 20 are provided for the inlet chambers 16 whereas covers 22 are provided for the outlet chambers 18. It will be noted by reference to FIGURE 2 that the outlet chamber is slightly enlarged as compared to the inlet chamber and the purpose of this will become more apparent later in the specification when the metering rolls, generally designated at 24, are described. The covers 20 and 22 are provided to the inlet and outlet chambers 16 and 18, respectively, of each of the vessels or tanks 10, 12 and 14 so that if the particular type of continuous liquid treatment involves the elevating of pressure within the tank, such may be accomplished.

It will be noted by reference to FIGURES 1, 2 and 3 that a loading tank 26 is provided adjacent the first J-box tank 10. The loading tank 26 is provided with a wetting liquid WL having a level N therein. The textile material T in rope form is fed into the loading tank 26 in a relaxed condition through a suitable port 28 and then downwardly over a roller 30 into the liquid WL and then upwardly over a second roller 32 positioned beneath the level of liquid and adjacent the bottom of the tank. Arrows are provided in both FIGURES 1 and 2 to show the direction of feed of the textile material T in rope form through the loading tank 26. In the upper portion of the loading tank 26 above the level N of liquid WL there are provided a set of metering rolls 24, three of which are shown in FIGURE 2, for purpose of description. The metering rolls 24 are positively driven through a chain and sprocket arrangement generally designated at 34. A variable speed electric motor 36 illustrated in broken lines in FIGURE 2 drives the chain and sprocket arrangement 34 in such a manner as to rotate the metering rolls 24 in a direction for pulling the textile material T upwardly out of the liquid WL.

The upper end of the loading tank 26 is provided with a cover 22 similar to the covers 22 for the outlet chambers 18 of the J-box tanks 10, 12 and 14. Cover 22 of loading tank 26 is provided with a jet fitting 38 aligned with a textile material outlet opening and pot eye. The jet fitting 38 may be identical in construction to the annular jet nozzle and venturi arrangement disclosed in the aforementioned United States Patent No. 2,978,291

and to this extent the disclosure in the aforementioned patent forms a part of the present disclosure. The textile material T in rope form after being fed upwardly through the loading tank 26 and about the metering rolls 24 therein, is fed through the jet nozzle and venturi arrangement of the fitting 38 into a conduit 40 connected to the fitting at 42 and to a tubular fitting 44 extending through the cover 20 of the inlet chamber 16 of tank 10. The conduit 40 provides a confined path for the textile material T as it is drawn or conveyed by a jet of liquid in the fitting 38 with the assistance of the metering rolls 24 from the loading tank 26 to the first liquid treatment tank 10.

The jet nozzle or fitting 38 has a liquid inlet 46 which is connected by pipe means 48 to the tank 10 at 50. Pipe means 48 has therein a pump P driven by a variable speed electric motor 52, the pump P being arranged to pump liquid L from the bottom of tank 10 in the direction of the arrows of FIGURE 1 upwardly to and through the fitting 38 where the liquid is discharged as a high speed jet stream of liquid in a direction to cause the textile material T in the conduit 40 to move toward and into the tank 10. Also, it will be noted that the pipe means 48 includes a heat exchanger 54 having a steam inlet 56 and a steam outlet 58. When it is desired to heat the liquid in the tank 10, steam is supplied through the heat exchanger 54 as the liquid from the tank 10 is recycled through the pipe 48 into the fitting 38 and conduit 40. Suitable thermostatic control may be utilized to maintain the liquid L in the tank 10 at a desired temperature. Since the tank 10 is completely enclosed, the heating of the liquid L therein also raises the pressure in the tank. If it is not desired to have the tank 10 pressurized, relief valves (not shown) in the upper end of the tank may be opened to atmosphere.

The loading tank 26 primarily serves a two-fold purpose. First, it serves as a wet out chamber to provide a seal for the system if the system is to be pressurized. Secondly, it provides for uniform moisture conditions in the textile material to be sequentially treated in the treating tanks 10, 12 and 14. Additionally, the tank 26 provides a fabric feed-in chamber wherein the fabric in rope form may be fed in a relaxed condition to the first set of metering rolls 24 and to the first jet fitting 38.

Each of the J-box tanks 10, 12 and 14 are substantially identical in construction and configuration and, therefore, a description of one will suffice for all.

As best shown in FIGURE 2, the J-box tank 10 in its inlet chamber 16 is provided with a doffing jet nozzle 60 which may be supplied with a fluid under high pressure, preferably the liquid L which is in the tank. This may be accomplished by suitably connecting the nozzle to the outlet of the pump P so that a portion of the liquid discharged from the pump P flows to the nozzle 60 whereas the other portion flows through the heat exchanger 54 into the jet fitting 38. It will be noted in FIGURE 2 that the fitting 44 extending through the cover 20 of the tank 10 has its discharge end extending at an angle as indicated at 62. This causes the textile material T being discharged downwardly into the tank 10 to be fed towards one wall of the same. The jet nozzle 60 which is located slightly below the discharge end 62 of the fitting 44 is directed at a downwardly extending angle in an opposite direction to the angle of the discharge end 62 and thus, the liquid discharging from the nozzle will impinge upon the textile material T and cause the same to be directed back toward an opposite wall of the chamber 16 and, thus, to neatly plait or pile as it is fed downwardly into the lower curved portion of the tank 10.

Tank 10 is provided in the inlet chamber 16 with a pair of opposed perforated grates 64 and 66 which define an inlet to the liquid containing portion of the tank. Since it is preferable to have the textile material T follow a semi-circular path in the bottom portion of the tank 10, a curved false bottom 68 is provided, the false bottom hav-

ing a plurality of perforations 70 punched therein as shown in FIGURE 4 so that there can be substantially unobstructed flow of liquid through the bottom portion of the tank 10.

The outlet chamber 18 of the tank 10 is provided just above the surface of the liquid M with a pair of opposed perforated grates 72 and 74, the purpose of the grates 72 and 74 being to permit fast separation of liquid L from the textile material T as it is drawn upwardly out of the liquid through metering rolls identical to those hereinbefore described and identified by the number 24. The metering rolls in the upper portion of the outlet chamber 18 of tank 10 are driven by a separate variable speed electric motor also identical to the previously described motor 36. The cover 22 of the outlet chamber 18 of the tank 10 is provided with a jet fitting 38' identical to the previously described jet fitting 38, the jet fitting 38' being connected to a closed conduit 40' extending therefrom to an inlet fitting 44' on the cover 20 of the inlet chamber 16 of the second liquid treatment tank 12.

The tank 12 adjacent its lower end is provided with a liquid outlet 50' to which is connected pipe means 48' extending upwardly to the jet fitting 38'. The pipe means 48' is provided with a pump P' driven by a variable speed electric motor 52' and on the outlet side of the pump P' there is also provided a heat exchanger 54' for heating the liquid L', if desired, as the liquid is recycled from the tank 12 back to the tank 12.

The outlet chamber 18 of the J-box tank 12 is similarly constructed to that of the J-box 10 as well as that of the loading tank 26 in that it is provided within its upper end with its set of metering rolls 24 separately driven by a variable speed electric motor 36 through a suitable chain and sprocket arrangement. The cover 22 of the outlet chamber 18 of tank 12 has a jet fitting 38'' therein which has a liquid inlet connected to pipe means 48'' extending from the lower portion of tank 14, the pipe means 48'' having a pump P'' driven by a variable speed electric motor 52''. The pipe means 48'' also is provided with a heat exchanger 54'' for heating liquid L'' as it is being recycled from and back into the third liquid treating tank 14 if it is so desired to heat the liquid L''. Jet fitting 38'' is connected to a conduit 40'' extending to an inlet fitting 44'' in the cover 20 of the inlet chamber 16 of tank 14.

Since tank 14 is the last of the series of treating tanks, for the purpose of this description, it differs slightly from the tanks 10 and 12 in that there is no necessity of providing a jet fitting on its cover 22 of its outlet chamber 18. Instead, a pot eye arrangement 78 is provided and the textile material T is then passed out of the pot eye 78 through a suitable drier 80 if such is desired and then rolled as indicated at 82.

It will now be appreciated by those skilled in the art that any number of treating tanks may be used according to the present invention so long as there are at least two. If the particular treatment of the textile material T involves the immersion of the material in four or five liquids, some of the liquids being different, then, of course, four or five tanks, respectively, will be connected in the manner just previously described. In some instances, there may be twelve or more tanks connected in series and some of the tanks may have the same treating liquid therein when the particular treating process requires more time in one liquid or another.

Each of the tanks 10, 12 and 14 is provided with an ultrasonic generator 84 operated pneumatically by steam supplied through the pipe 86. The purpose of providing ultrasonic generators above the level of liquid in the tanks is to reduce the foam in the tanks 10, 12 and 14 when the liquid used is subject to foaming thereby eliminating shutdown of the apparatus due to pump surging. Such a condition might be encountered in the desizing of textile material with enzymes where there is saponification of the waxes and fats in the greige cloth.

Since tank 14 as described above is the terminal tank

in the sequential liquid treatment of the fabric, the outlet chamber 18 above the level of liquid therein may be provided with squeeze rolls (not shown) through which the material is passed so as to eliminate as much liquid as possible from the fabric as it is discharged therefrom. It is also possible to use metering rolls in the tank 14 to function as squeeze rolls if such is desired.

Referring to FIGURE 3, it will be noted that a water supply conduit 90 is provided for supplying water from a suitable source to any of the particular tanks 10, 12, 14 and 26. Suitable valves 92 are provided in the water supply conduit so that the flow of water can be controlled as desired. A drain manifold 96 is also connected to each of the tanks of the apparatus, the drain manifold being provided with valves (not shown) for draining liquid from any or all of the tanks. Additionally, the apparatus is provided with chemical supply conduits 98 extending to the various tanks 10, 12 and 14 for supplying chemicals to any of the particular tanks. The chemical supply manifold may also be used throughout a run to supply the necessary acid or base to control the pH of the treating liquid in a particular tank. In this respect, return conduits 100 are provided for draining a certain portion of the liquid from a particular tank when the pH of that tank must be changed.

By having separate electric motors 52, 52' and 52'' for operating the pumps P, P' and P'', respectively, the individual jet streams of the jet fittings 38, 38' and 38'' may be accurately controlled and adjusted for a particular run. Also, by utilizing individual electric motors, such as the motor 36, to drive the metering rolls 24 in the various tanks, the speed of the metering rolls may be adjusted to compensate for fabric weight change at the liquid interface. The speed of the motors 36 is automatically controlled through a switch 102 actuated by a rake type cloth level indicator 104 provided in the inlet chambers 16 of each of the tanks 10, 12 and 14. The cloth entering a particular inlet chamber 16 strikes rake type indicator 104 when there is too much of a build up of cloth in that particular chamber and pivots it so that it contacts the switch 102 which in turn controls the speed of the motor for the metering rolls. This will slow down the metering rolls 24 delivering the cloth with the assistance of the jet fitting to that particular inlet chamber 16. Such an arrangement provides for synchronization of the range of feed of the cloth to the tanks 10, 12 and 14 and maintains the cloth at a desired level in each of the tanks 10, 12 and 14.

The method described herein may be used in the continuous liquid treatment of all types of textile material in rope form. Typically, woven and non-woven fabrics of synthetic and natural fibers or blends of the same may be processed by a liquid treatment dyeing operation, or a bleaching operation, or a desizing operation, or a scouring operation, or the like or in a combination of these operations depending upon the number of tanks arranged in series and the desirability for a particular plant production.

As a typical example of the operation of the present invention but not limiting the operation of the present invention, a greige cloth having a fiber content of cotton and woven with 112 number of warps and 68 number of fillings was bleached. The particular apparatus used included the sequential and continuous treatment in twelve liquid treating J-box tanks arranged in series. The first two J-box tanks had a desizing liquid bath using enzyme at a temperature in the range of 155° to 160° F. The next two tanks in series contained a water bath at a temperature of 180° F. The third two tanks in series were utilized for a caustic boil of the fabric and had a 3% caustic liquid therein at a temperature of 210° F. Then there were two additional tanks containing water for washing the fabric after the caustic boiling, these two tanks having water at a temperature of 180° F. After the greige cloth of fabric had been desized, washed, caustic boiled and

again washed, it passed through two tanks having a sodium chloride bleach of .1%, the temperature of the bleach being 195° F. By using .1% of sodium chloride bleach or one gram of sodium chloride bleach per liter of water, there was no concern of carrying the bleach over to the next step of the operation because the bleach concentration was quite low and yet adequate. The final step of the operation included passing the fabric through two final tanks of water at a temperature of 70° F., the fabric again being washed. Upon emerging from the final tank of water, the fabric passed through squeeze rolls to eliminate as much of the water as possible. In the continuous bleaching operation heretofore described, the jet fittings of each of the tanks discharged liquid in the confined path at 30 to 40 p.s.i. with velocity of the jet stream being 120 to 150 f.p.s. The dwell time for the fabric in each J-box tank was in the order of six minutes as compared to seventy minutes in prior continuous liquid treatment systems. All of the twelve tanks mentioned above were connected in series as described heretofore in the specification. Of course, if desired, the above continuous bleach operation could be made in separate steps by moving the cloth from one series of tanks to a second series, in parallel with the first series of tanks, the tanks of each of the series having the basic steps successively therein.

The above described method of the present invention has advantages over prior continuous liquid treatment processes or batch processes in that it has versatility, quality, economy, simplicity and capacity. With respect to versatility, the method of the present invention is capable of handling a wide range of fabric weights and constructions including a number of fabrics which heretofore have only been run successfully in open width ranges. With regard to quality, fabrics treated by the present method show no degradation, loss of fiber strength, rope marks, rub marks or other deficiencies common in conventional operations. The floor area required for the present process and apparatus is approximately 25% of that required by the conventional continuous range operation whereas the head room is just 50% of that previously required. Additionally, the operating costs are substantially lowered in that less chemicals, water and steam are used. Since the liquid treating tanks or chambers are substantially identical, and are compactly arranged with full automatic control, there is simplicity in operation as one man is capable of fully operating the apparatus for a complete continuous bleach range. The system is fully sealed and, therefore, loss of heat and emission of vapor is eliminated. The capacity of the system is increased over previous systems in that production rates of 12,000 pounds of fabric per hour are possible at cloth speeds in the order of 300 yards per minute.

While the improved method for the continuous liquid treatment of fabrics as described and illustrated in the drawings fully and effectively accomplish the objects and advantages of the present invention, it will be appreciated by those skilled in the art that certain modifications or changes may be made to the process without departing from the principles and spirit of the present invention.

Therefore, the terminology used throughout the specification is for the purpose of description and not limitation, the scope of the invention being defined in the claims.

What is claimed is:

1. A continuous process for treating textile material in rope form sequentially in at least two treating liquid baths comprising the steps of: providing a confined path for the textile material leading to an area above the liquid in the first bath; withdrawing a portion of the liquid from the first bath and discharging the same as a high speed jet stream of liquid into the confined path in a direction toward the first bath whereby the liquid is recycled into the first bath; feeding the textile material in rope form to the confined path and into the jet stream of liquid whereby the jet stream of liquid carries the textile material through the confined path and discharges the same downwardly into the first bath; providing a second confined path extending from an area above the first bath to an area above the second bath; withdrawing a portion of the liquid from the second bath and discharging the same as a high speed jet stream of liquid into the second confined path in a direction toward the second bath whereby the same is recycled into the second bath; feeding the textile material in rope form from the first bath upwardly to the second confined path and into the jet stream of liquid therein whereby the textile material is carried through the second confined path into the second bath; and withdrawing the textile material from the second bath.

2. The process as claimed in claim 1 including positively assisting the feeding of the textile material by the jet stream of liquid in the respective confined paths.

3. The process as claimed in claim 1 including directing a stream of liquid against the textile material in rope form as it is being discharged from the confined paths downwardly into the baths so that the textile material plaits in the bath.

4. The process as claimed in claim 1 including separating the liquid from the textile material as the textile material is fed upwardly from the baths and prior to its being received into the jet stream of liquid in the respective confined paths.

5. The process as claimed in claim 1 including placing each of said baths and said confined paths under pressure.

6. The process as claimed in claim 1 including wetting the textile material prior to its being fed into the jet stream in the first confined path.

7. The process as claimed in claim 1 including using different treating liquids in the baths.

8. The process as claimed in claim 1 including heating the treating liquids after the treating liquids have been withdrawn from the respective baths and prior to the discharge of the treating liquids as high speed jet streams of liquid in the respective confined paths.

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